#IRENA insights
WEBINAR SERIES

IRENA
International Renewable Energy Agency

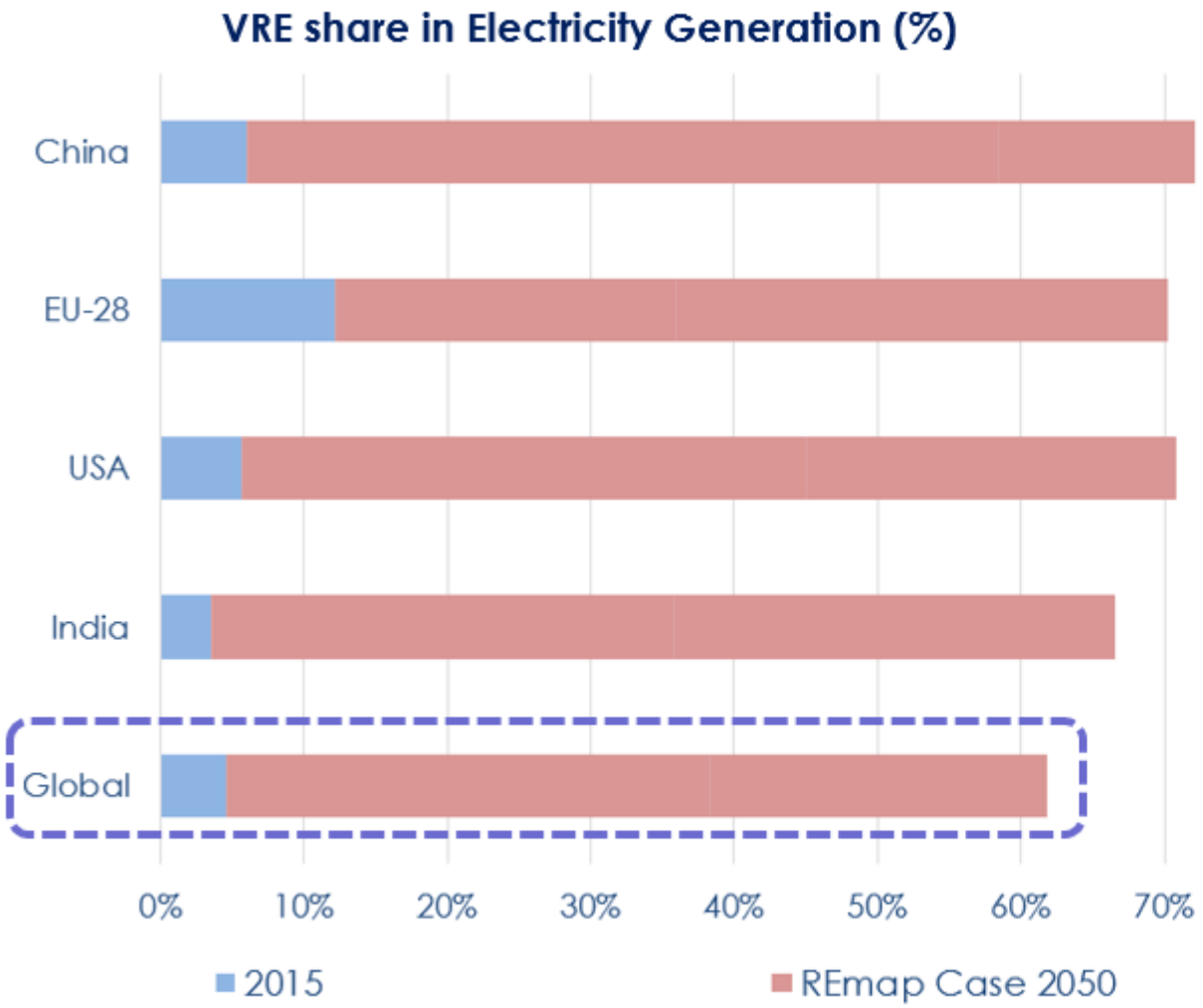
Electric Vehicles: how smartly should we charge them?

Presenters:

- Arina Anisie, Renewable Energy Innovation team
- Francisco Boshell, Team lead Renewable Energy Technology, Standards and Markets

TUESDAY, 21 JANUARY 2020 • 10:00 – 10:30 CET

Wind and PV at the core of the energy transition

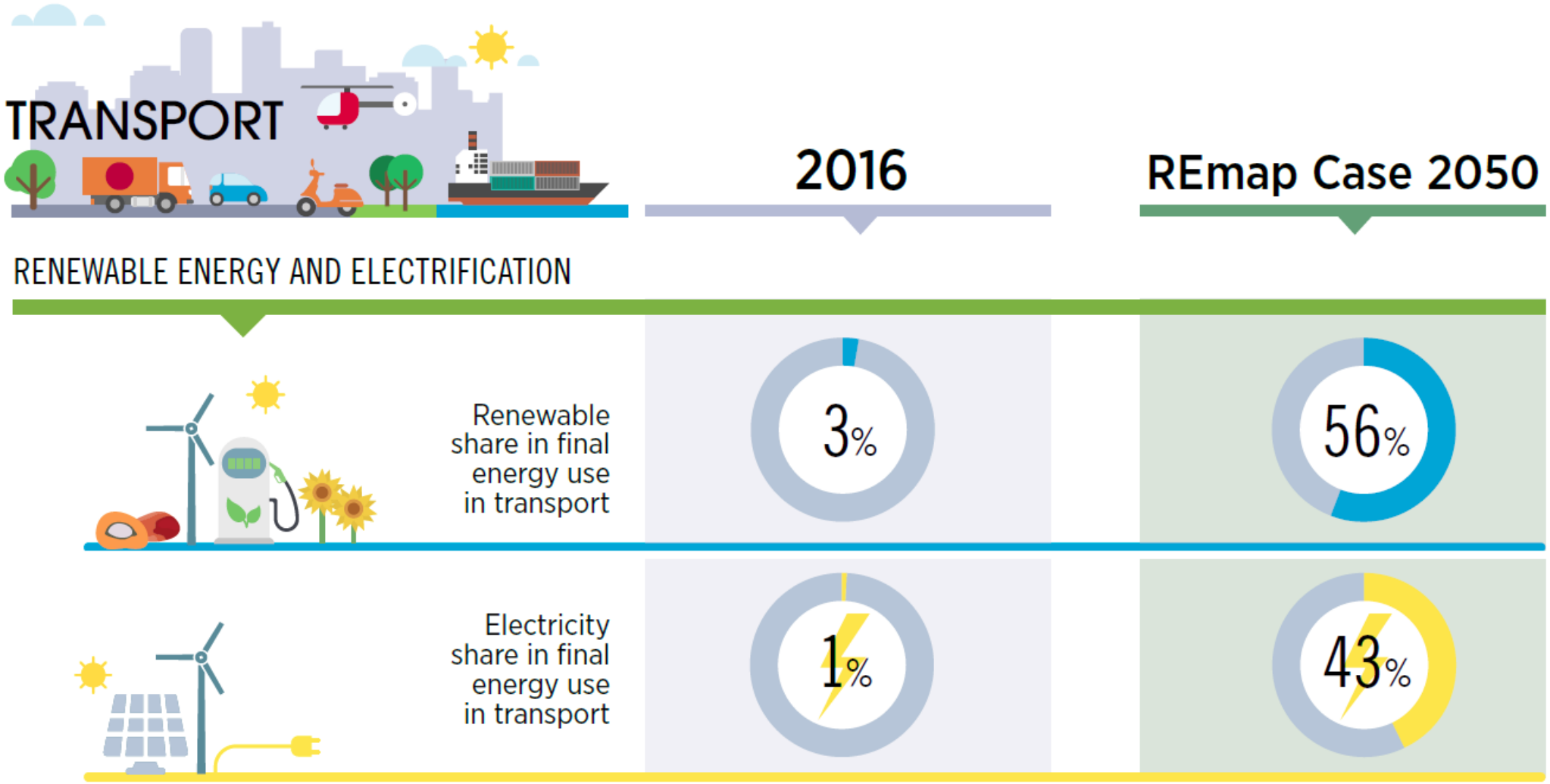


> 60% Global VRE Share by 2050 in Paris Agreement aligned case

- Wind and PV are **variable energy sources** – addressing variability is crucial for high deployment.
- Today's innovation challenge – **integrating high shares of wind and PV at lowest-cost** in power systems.
- **Power-system flexibility** is key to the cost-effective use of renewables.

Source: IRENA (2019), Innovation landscape for a renewable-powered future: Solutions to integrate variable renewables

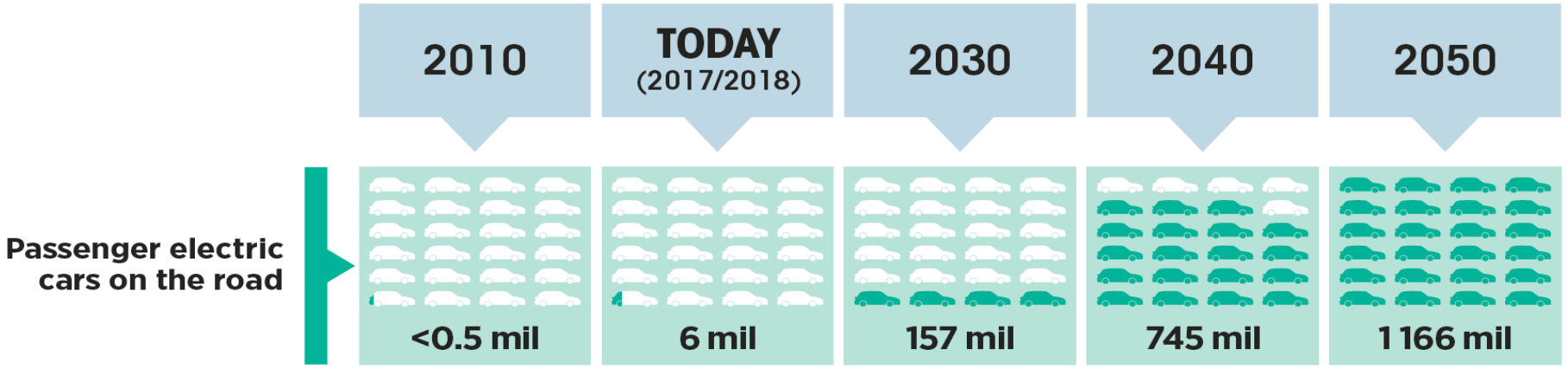
Electricity to become the main energy carrier



Source: IRENA Global Energy Transformation: A roadmap to 2050 (2019 edition)

Uptake of EVs - the battery bank of the future

Growth in EV deployment between 2010 and 2050 in a Paris Agreement-aligned scenario



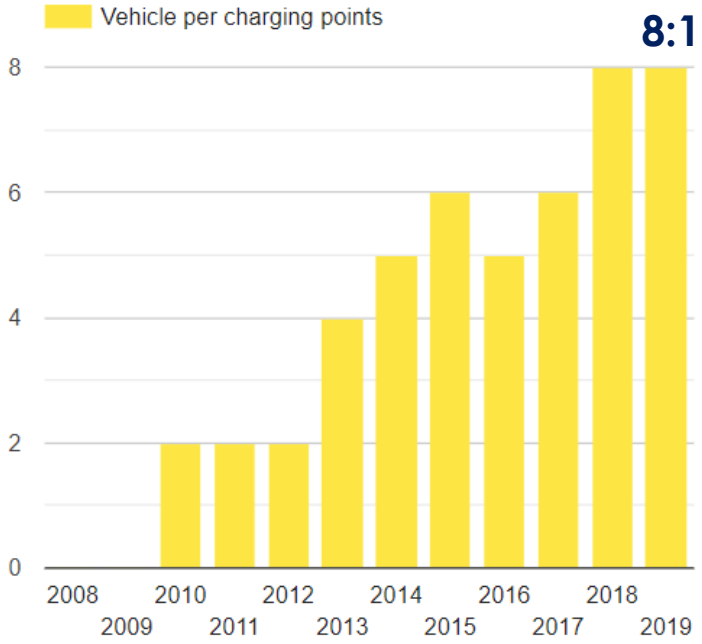
By 2050, potential storage capacity to provide grid services:

~ 14 TWh EV batteries vs ~ 9 TWh stationary batteries

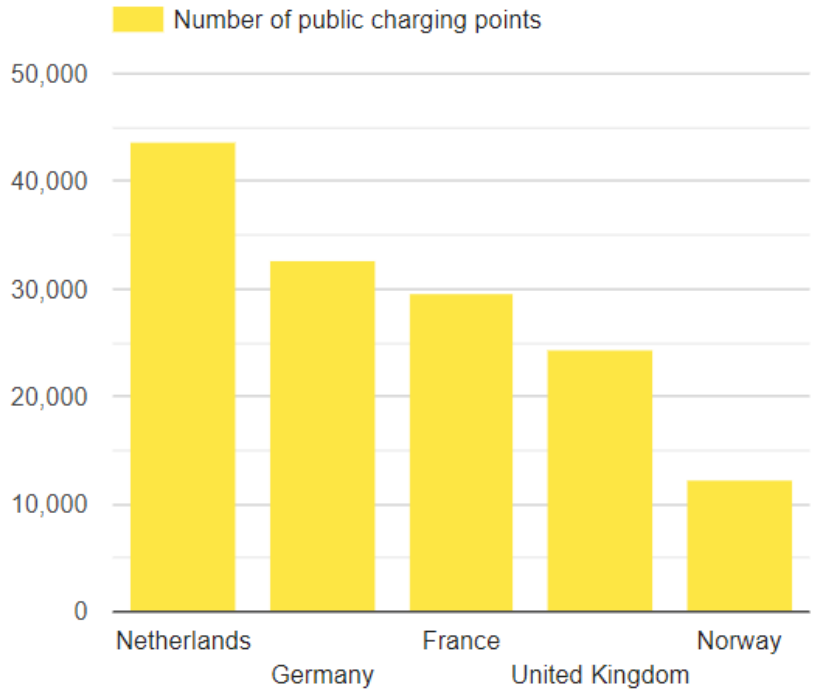
Source: IRENA (2019) Innovation Outlook: Smart charging for Electric Vehicles

Charging infrastructure – Example of Europe

Plug-in EV (PEV) per Public Charging Point in Europe



Top 5 European Countries Number Of Public Charging Points in 2019



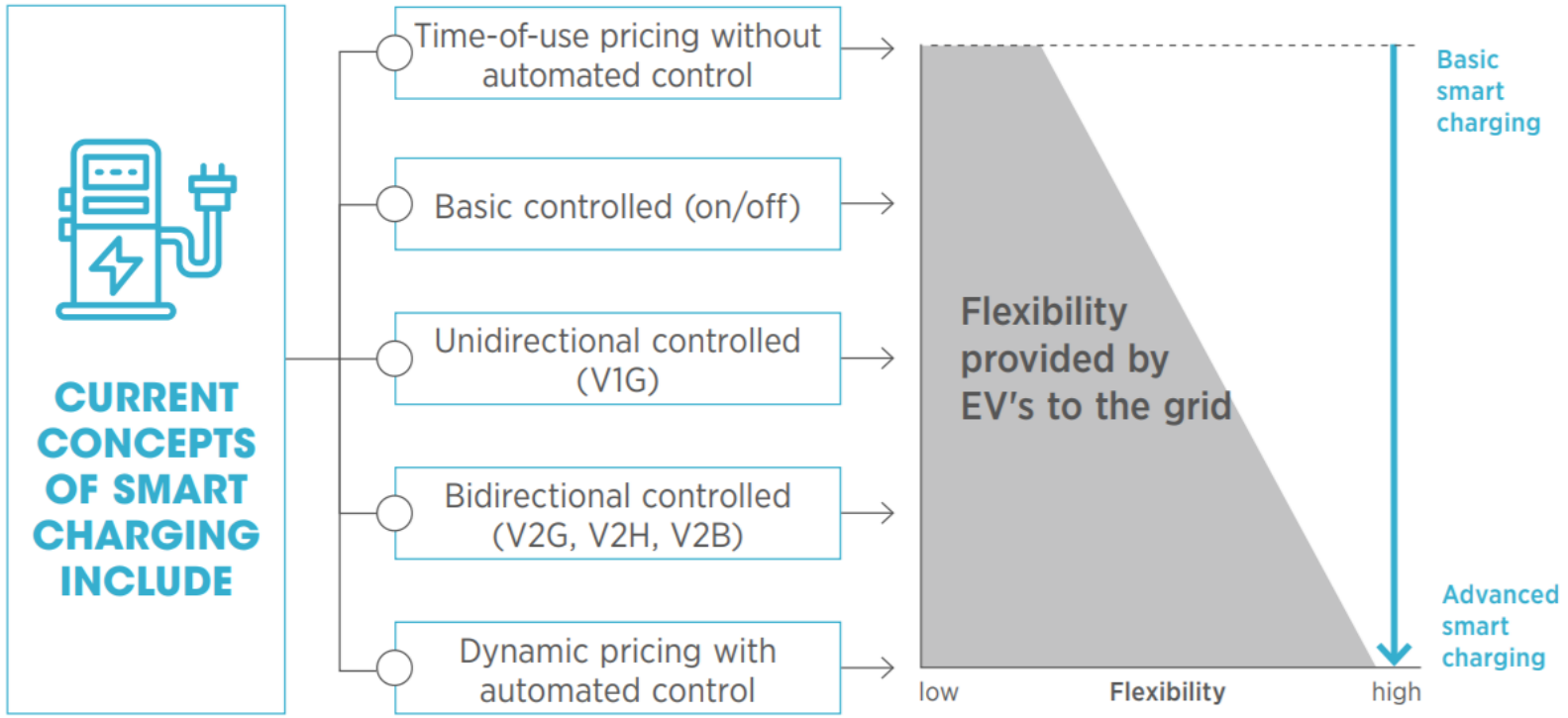
- Globally by end of 2019 ~ 880k Public Charing Points (PCP) | Europe ~ 185k PCP
- Europe PEV / PCP ratio today around 8:1
- European Commission: 1 million PCP in Europe by 2025

Source: Based on data from the European Alternative Fuels Observatory

EV Smart charging

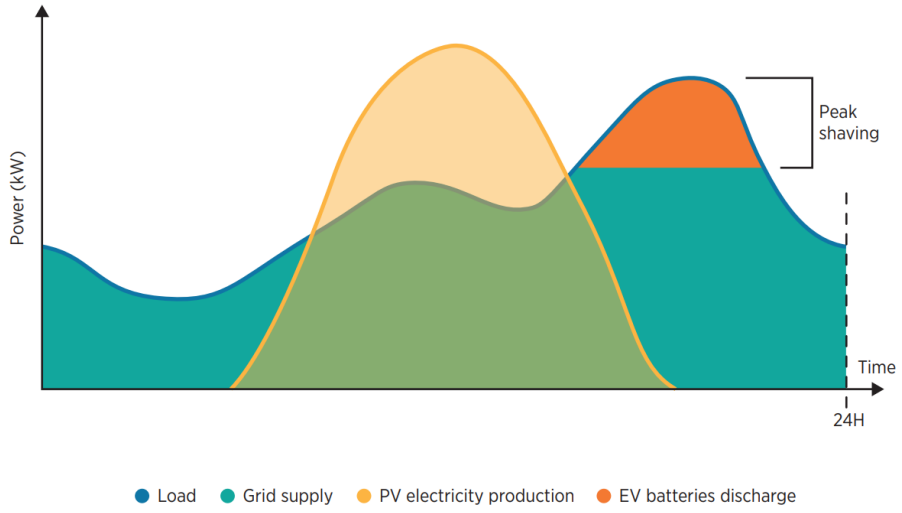
Smart charging means adapting the charging cycle of EVs to both the conditions of the power system and the needs of vehicle users.

This facilitates the integration of EVs while meeting mobility needs.

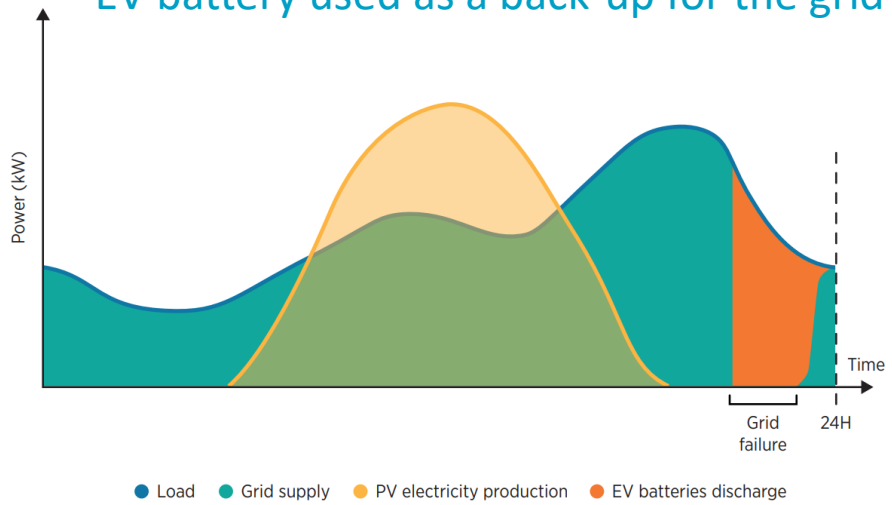


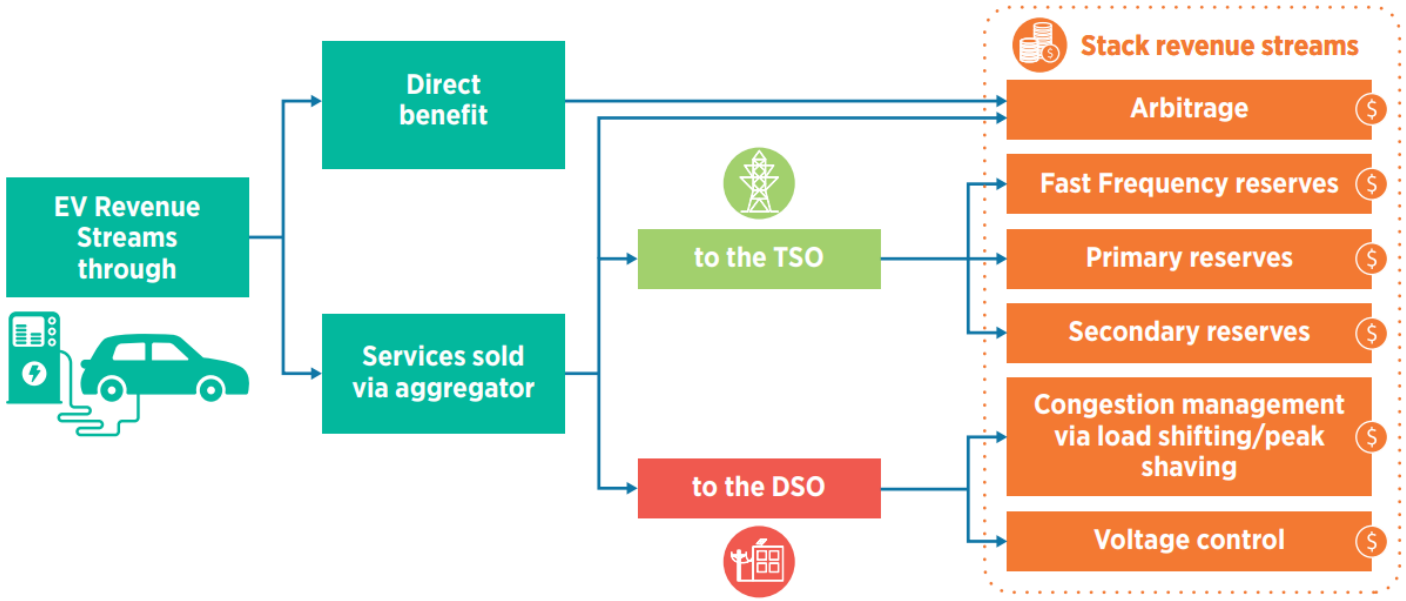
Vehicle-to-grid Smart Charging

EV battery used for peak shaving



EV battery used as a back-up for the grid





Market structure and regulation that enables V2G charging

Impact of smart charging on grid infrastructure

Case study: EVs impact on Hamburg's distribution grid

Stromnetz Hamburg assessment: 9% EV share (60.000 EVs) would cause bottlenecks in 15% of the feeders in city's distribution network

Option A: Grid reinforcement solution

- Reinforcing ~ 10 000 km of 0.4 kV cable lines, replacing trasformers
- Construction works for many months, closing of roads
- Estimated investment: **20 million EUR**

Option B: Smart digital solution

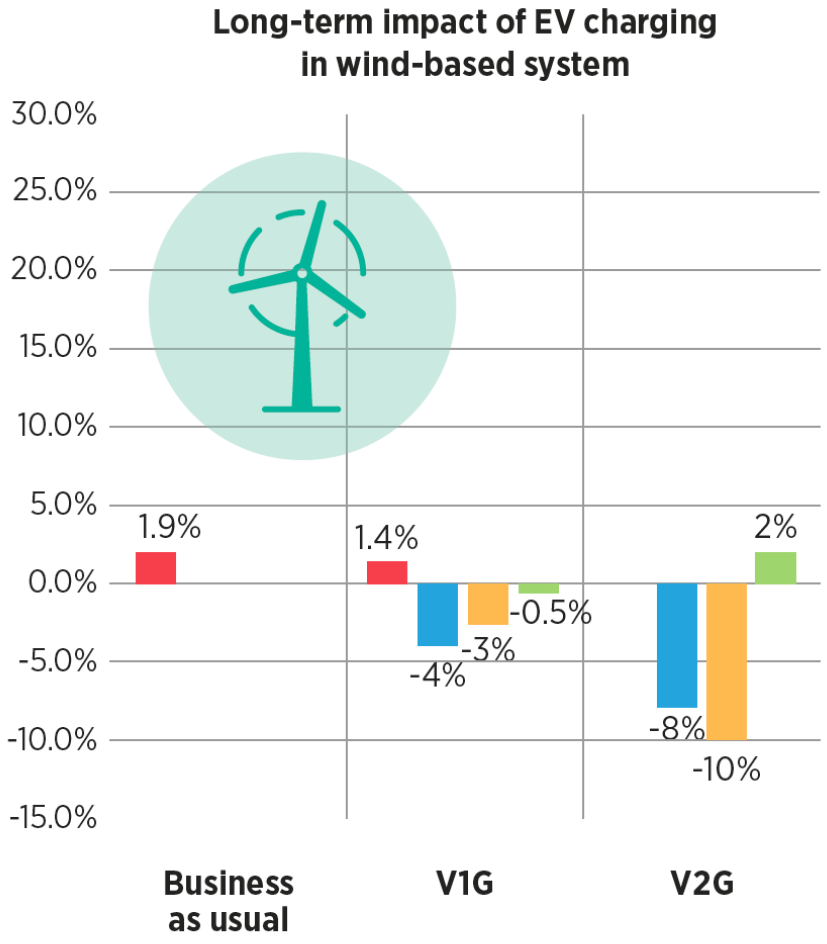
- Decrease the simultaneity. All charging points need to be visible by the DSO
- A real-time communication system enables DSO to reduce charging points loads.
- Estimated Investment: **2 million EUR**

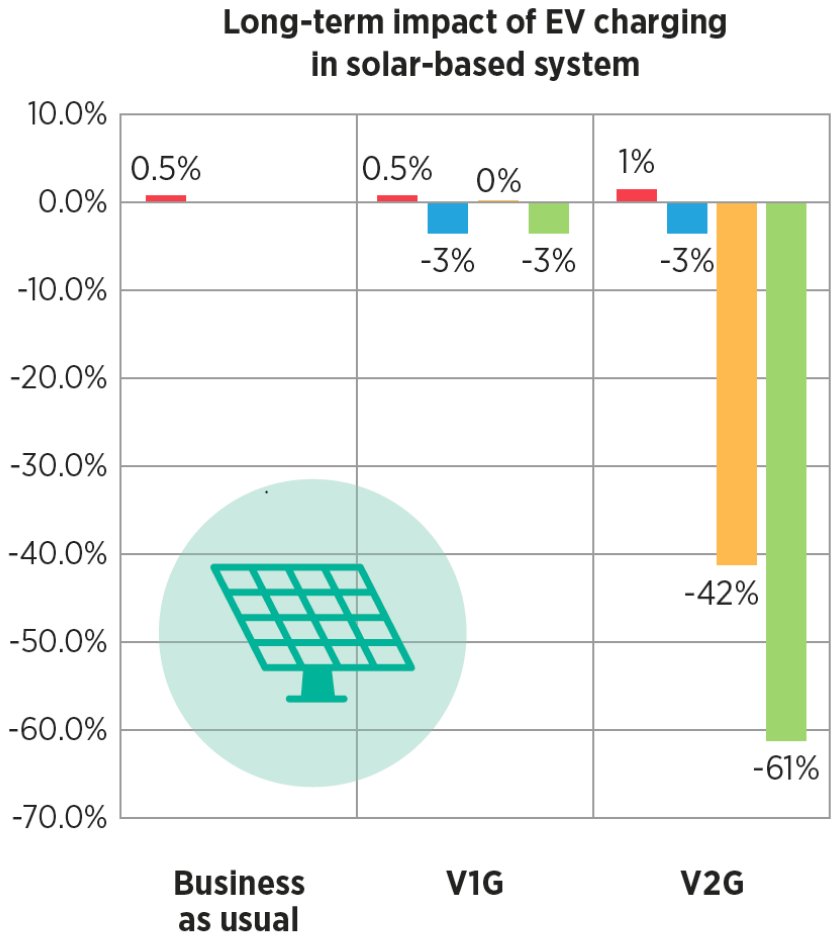
90% grid investment savings with smart solution

Source: IRENA (2019) Innovation Outlook: Smart charging for Electric Vehicles

Impact of smart charging on solar PV and wind integration

- Smart charging cuts peak load, reduces curtailment and allows higher shares of low-cost PV electricity.
- This can help to displace more expensive generation and lower electricity prices.
- Higher impact on PV than wind due to generation profiles





Curtailment
Change in yearly peak load (%)
Change in average short-run marginal cost (%)
Change in CO_2 emissions (%)

Source: IRENA (2019) Innovation Outlook: Smart charging for Electric Vehicles

Charging infrastructure

How?

- Fast and ultra fast charging - priority for mobility sector
- But, slow charging - better for smart charging
- Fast charging increasing stress on local grids - Battery swapping, charging stations with buffer storage might be necessary

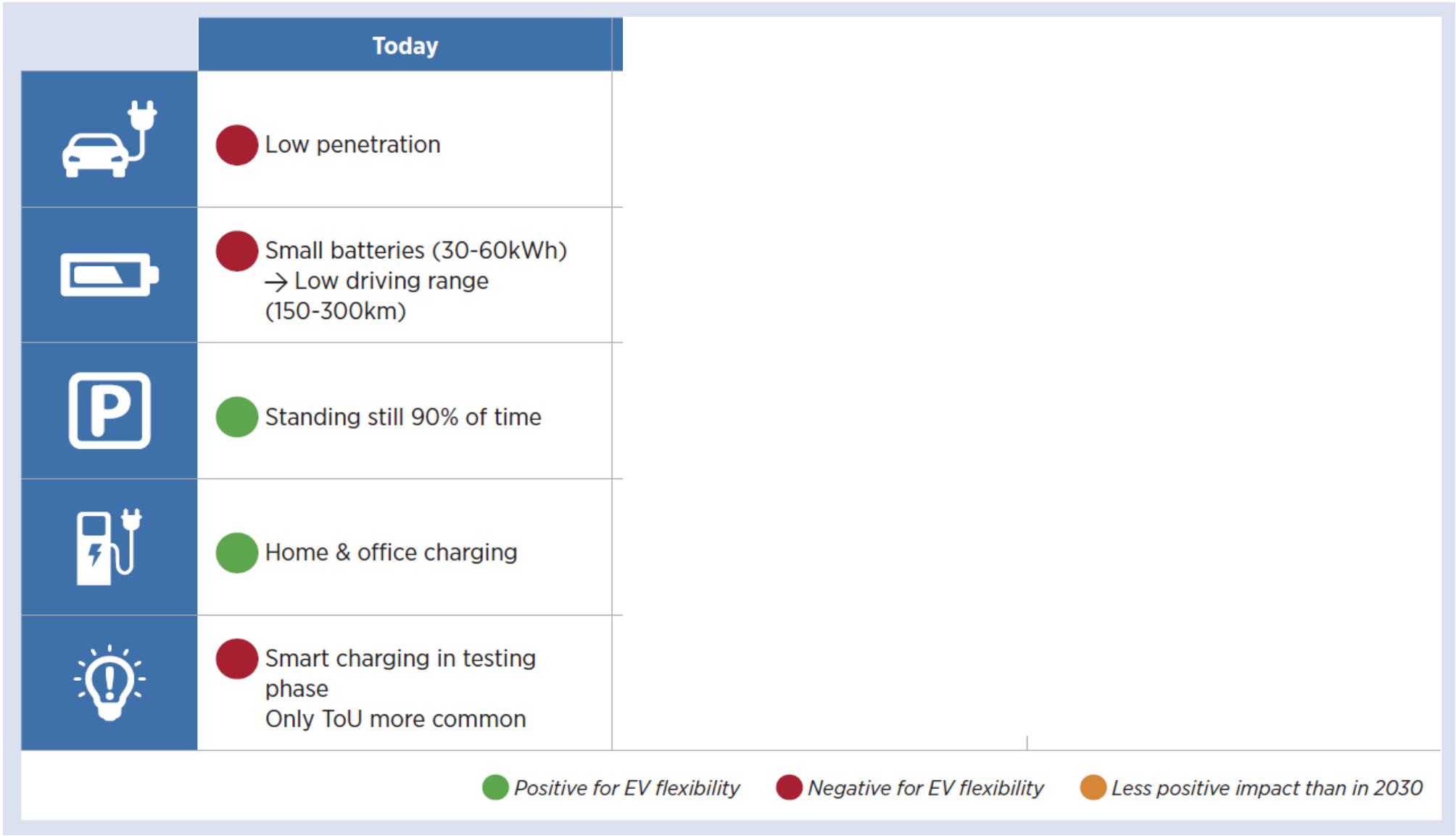
	Electricity demand	Peak demand	Distribution grids
Slow charging, uncontrolled	+	++	++
Slow charging + smart charging	+	+	+
Fast charging	+	++	++
Fast charging with batteries	+	+	+

	Privately owned cars	Shared mobility	Public transport	Two-wheelers	Prevailing type of charging
Low-income, dense metropolitan areas			++	++	Public charging, hubs for buses
High-income suburban sprawl	++	+	+		Home charging
High-income, dense metropolitan areas	+	++			Charging hubs, more fast charging

Where?

- Location of slow charging points - at home/workplace to be considered at planning

Possible evolution of EV flexibility by 2030 and 2050



Guidelines for policy makers

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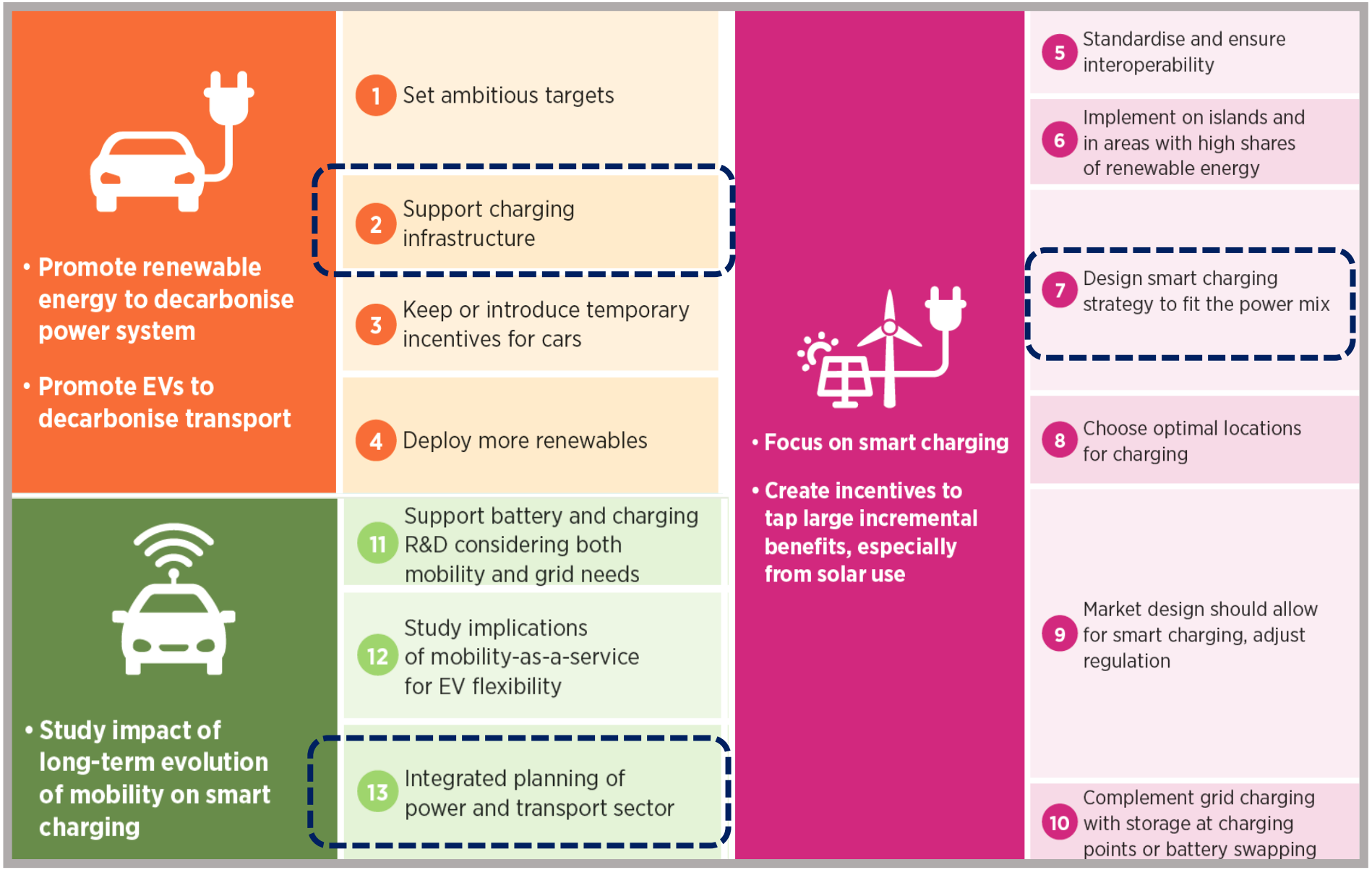

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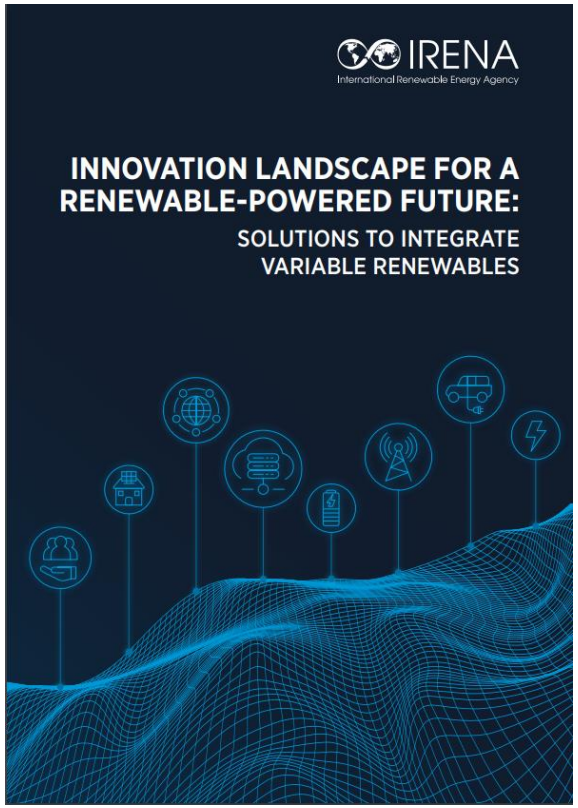
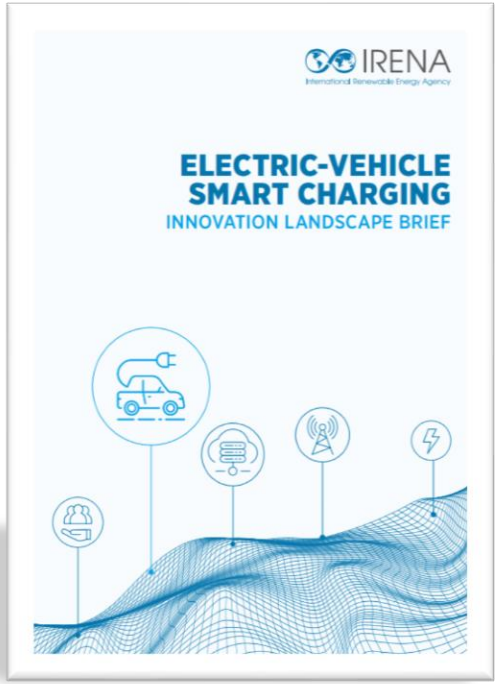
Further reading

IRENA (2019), Innovation Outlook smart charging for Electric Vehicles: **Link**



IRENA (2019), Innovation Landscape for a renewable-powered future: *Solutions to integrate variable renewables:* **Link**



IRENA (2019), Innovation Landscape Brief: Electric-Vehicle Smart Charging: Link

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Questions & Answers

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  "Where is renewable energy innovation heading? – What patents data can tell us"

- ❑ TUESDAY, 21 February 2020 • 10:00 – 10:30 CET
  "Grid Stability with High Share of Renewables - Transforming Small Island Power Systems"

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Thank you!

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